Research Brief for Forest Managers

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10-Year Post-Treatment Carbon Dynamics

Forests play a vital role in regulating climate by sequestering carbon from the atmosphere. Fire results in direct and indirect emissions of carbon to the atmosphere. In historically frequent-fire forests, post-fire tree mortality was considerably lower than current mortality levels following high-severity wildfire in fire-suppressed forests. Treatments to reduce high-severity wildfire risk require carbon removal by thinning and carbon emissions by prescribed burning. Quantifying how these treatments influence total ecosystem carbon is necessary for better understanding the tradeoffs between treatment and wildfire severity.

In an on-going study at the Teakettle Experimental Forest we quantified the carbon consequences of different levels of thinning and burning treatments 10-years post-treatment. Treatment effects on carbon stocks varied with treatment intensity. However, ten years on, the burn-only and the understory thin treatments had re-sequestered all of the carbon lost during treatment (Figure 1). The understory thin and burn had a small negative carbon stock (Figure 1). The largest increase in the live tree carbon stocks occurred in the understory thin, while the understory thin and burn showed a slight decline in live tree carbon. This reduction was due to the mortality of several large trees following treatment.

Teakettle Experimental Forest, overstory thin and burn treatment.

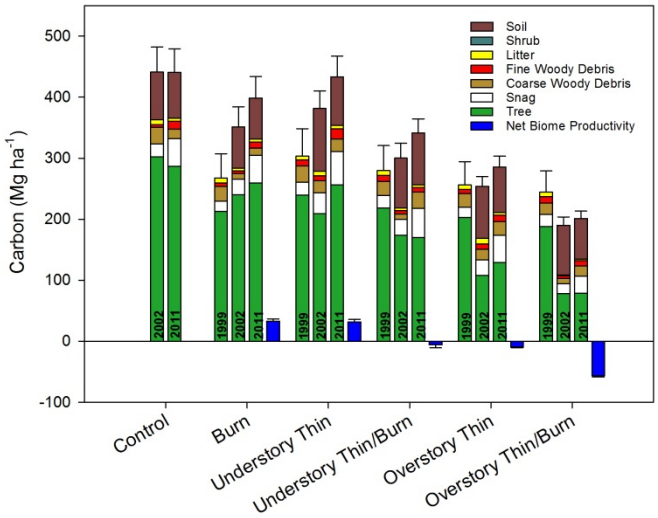

Figure 1: Mean and standard error of C pools pre-treatment (1999), immediately post-treatment (2002) and 10-years post-treatment (2011) in Mg C ha^{-1}. Ten-year net biome productivity (solid blue bar) is the 10-year net ecosystem productivity minus C removed and emitted during treatment implementation in Mg C ha^{-1}. Soil and shrub C values are not included in the pre-treatment (1999) C stocks.

The burn-only results demonstrate that the carbon sink strength of this historically frequent-fire forest can be maintained when natural fire is restored. The post-treatment mortality in the understory thin and burn suggests that planning for increased mortality from burning during stand marking is required to buffer against carbon loss. The overstory thin treatment was close to having a neutral carbon balance 10-years after treatment because of the proportion of harvested material that was converted to wood products. However, the overstory thin and burn will likely have a negative carbon balance for a considerable time period.

Management Implications:

- Restoring fire as a natural process does emit carbon to the atmosphere, but the emissions are re-sequestered by the remaining trees within the historical fire return interval.
- Thinning followed by burning can increase tree mortality and retaining additional large trees can help buffer the carbon loss from mortality.

References:

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